DC 16-Circuit Sink and Source I/O Blocks

May 2014 GFK-0043J

Description

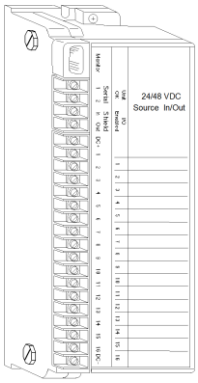
A DC 16-Circuit Source I/O Block is an intelligent, configurable module that can interface to a wide range of discrete DC sensors and actuators.

There are two DC 16-circuit source blocks, which provide current to field output devices:

- **24 Vdc Source Block**, for use with 2- and 3-wire solid-state sensors and electromechanical sensors.
- **24/48 Vdc Source Block**, for use with 3-wire solid-state sensors and electromechanical sensors.

There are also two DC 16-circuit sink blocks, which receive current from field output devices:

- **24 Vdc Sink Block**, for use with 2- and 3-wire solid-state sensors and electromechanical sensors.
- **24/48 Vdc Sink Block**, for use with 3-wire solid-state sensors and electromechanical sensors.



Note: IC66*BRD020 & IC66*BRD021 contain blocking diodes and feedback resistors for specific redundancy applications (see *GFK-1277).*

Features

These blocks have 16 discrete circuits, each easily configured to be an input, a tri-state input, or an output. Output circuits can be connected directly to input circuits without the use of other components or inversion of logic states.

Control power is tapped off the input/output device voltages wired to the terminals. No separate block power supply is needed.

Configurable features include:

- Output Pulse Test capability
- Selectable Input Filter Time from 10ms to 100ms
- Output power-up defaults
- Output Hold Last State or default

The block's advanced diagnostics can pinpoint causes of installation and run-time errors. Diagnostics features of these blocks include:

- Electronic short circuit protection
- Over-temperature protection
- Failed switch detection
- Open wire detection for tri-state inputs
- Overload detection and shutdown
- No-load detection

Specifications

Catalog Numbers	*Standard Block*	*GMR Block*
24/48 Vdc 16 Circuit Source I/O Block	IC66*BBD020, 6240BP10811D-	IC66*BRD020
Terminal Assembly only	IC66*TSD020	IC66*TRD020
Electronics Assembly only	IC66*EBD020	IC66*ERD020
24 Vdc 16 Circuit Source I/O Block	IC66*BBD022, 6240BP10411D-	
Terminal Assembly only	IC66*TSD022	
Electronics Assembly only	IC66*EBD020	
24/48 Vdc 16 Circuit Sink I/O Block	IC66*BBD021	IC66*BRD021
Terminal Assembly only	IC66*TSD021	IC66*TRD021
Electronics Assembly only	IC66*EBD021	IC66*ERD021
24 Vdc 16 Circuit Sink I/O Block	IC66*BBD023	
Terminal Assembly only	IC66*TSD023	
Electronics Assembly only	IC66*EBD021	

Block Specifications		
Size (height x width x depth)	8.83" x 3.56" x 4.42" *22.44 x 9.05 x 11.23 cm*	
Weight	4 lbs. (1.8 kg)	
LEDs (I/O Block)	Unit OK, I/O Enabled	
LEDs (each circuit)	Individual load side indicators	
Block to block Isolation	1500V	
Heat Dissipation (16 outputs on at 2A)	68.8 Watts	91.5Watts
Operating voltage	18-56 Vdc (24/48 V), 18-30 Vdc (24 V)	
Ripple (maximum)	10%	
Required DC power	150mA typical, 300mA maximum	
Power supply dropout time	10ms	

Input Specifications			
For standard input, voltage relative to DC-		**Source**	**Sink**
Input ON	24 Vdc supply	16-24 Vdc	0-8 Vdc
	48 Vdc supply†	32-48 Vdc	0-16 Vdc*
Input OFF	24 Vdc supply	0-7 Vdc	17-24 Vdc
	48 Vdc supply†	0-14 Vdc	34-48 Vdc*
Input impedance (typical)		5.6kΩ (24/48V), 1.8 kΩ (24V)	
Input processing time (typical)		1.7ms (plus selectable filter delay)	
Selectable input filter times		5-100ms	
Input diagnostics		Open Wire, Over-temperature, Failed Switch	

Output Specifications	
Output current (steady state)	2 Amps per circuit
Maximum inrush current	10 Amps up to 10ms
Block output current	12 Amps at 60°C at 30Vdc 15 Amps at 35°C at 56Vdc
Output OFF leakage current	1.0 mA
Maximum switching frequency	Once per second (high inrush current)
Output turn-on delay (maximum)	1ms
Output voltage drop	2.0 volts maximum at 2 Amps inrush
Minimum Recommended Load	50 mA with No Load enabled
Output Diagnostics	Short Circuit, Overload, No Load, Failed Switch, Over-temperature

Environmental Specifications	
Operating Temperature	0°C to +60°C (32°F to +140°F)
Storage Temperature	-40°C to +100°C (-40°F to +212°F)
Humidity	5% to 95% (non-condensing)
Vibration	5-10Hz 0.2" (5.08mm) displacement, 10-200 Hz at 1G

Refer to GFK-0867 for product standards and general specifications.

† for 24/48 Vdc blocks only

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Using this Datasheet

This datasheet summarizes information about block installation, configuration, and diagnostics. Your primary reference should be the *Discrete and Analog Blocks User's Manual GEK-90486-2*. It includes detailed instructions for block installation and configuration.

For information about systems and communications, including bus specifications, refer to the *I/O System and Communications Manual GEK-90486-1*.

For details about GMR, refer to the *GMR User's Manual GFK-1277*.

Compatibility

The Terminal Assemblies listed below are not compatible with some earlier versions of the Electronics Assemblies.

Block Type	Terminal Assembly	Not Compatible with Electronics Assemblies
24/48 Vdc Source Block (IC66*BBD020, 6240BP10811D)	IC66*TSD020 (version C or later)	IC66*ELD020 any version IC66*EBD020 versions A to E
24/48 Vdc Sink Block (IC66*BBD021)	IC66*TSD021 (version B or later)	IC66*ELD021 any version IC66*EBD021 versions A to D
24 Vdc Source Block (IC66*BBD022, 6240BP10411D)	IC66*TBD022 (version B or later)	IC66*ELD020 any version IC66*EBD020 versions A to E
24 Vdc Sink Block (IC66*BBD023)	IC66*TBD023 (version B or later)	IC66*ELD021 any version IC66*EBD021 versions A to D

If the Terminal Assembly will be used to replace an earlier Terminal Assembly, and the Electronics Assembly is one of the incompatible versions listed above, the Electronics Assembly can be upgraded to make it compatible. Consider this alternative only where pulse-testing of even-numbered output circuits has become an issue for the application. Normal on/off operation of even-numbered circuits is not an issue for the older Electronics Assembly/Terminal Assembly combination.

To address the same issue, the IC66*BRD blocks compatibility matrix follows. For these blocks, there is no terminal assembly compatibility issue.

Block Type	Catalog #	Replaces
24/48 Vdc Source Block	IC66*BRD020F IC66*ERD020F	IC66*BRD020 versions A to E IC66*ERD020 versions A to E
24/48 Vdc Sink Block	IC66*BRD021B IC66*ERD021B	IC66*BRD021 version A IC66*ERD021 version A

Any Hand-held Monitor can be used with these blocks. HHM version IC66*HHM501 is required to change baud rate configuration or to configure the block for redundancy.

For an IC697 series PLC, the CPU and programming software must be version 2.0 or later. The bus controller must be IC697BEM731C or later.

For an IC600 series PLC, the CPU must be rev. 105 or later. For an IC600 series Plus PLC, rev. 110 or later is required. The programming software must be rel. 4.02 or later. If the bus controller is model IC66*CBB900, it must be version C or later. For an IC550 series PLC, the CPU must be rev. 3.0 or later. The programming software must be rel. 2.01 or later.

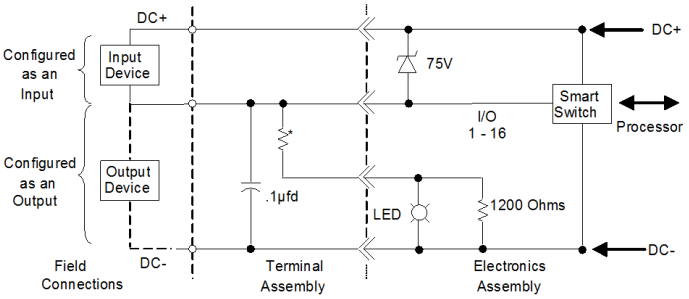
For an IC550 series PLC, the CPU must be rev. 3.0 or later. The programming software must be rel. 2.01 or later.

Block Operation

Each circuit can be configured as an input, a tri-state input, or an output. If the block is configured as a combination block, output feedback is provided via the corresponding input references.

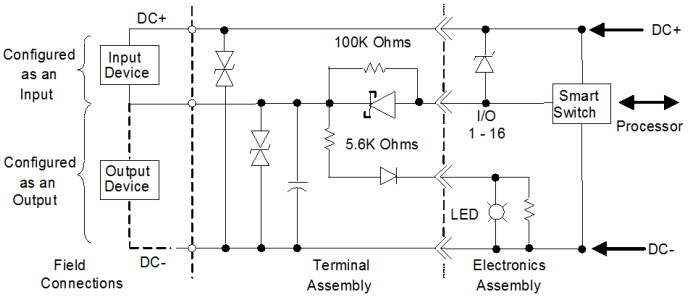
16 Circuit DC Source I/O Blocks

A DC source block has all output devices connected to the negative (-) side of the power supply. Inputs control the positive (+) side.



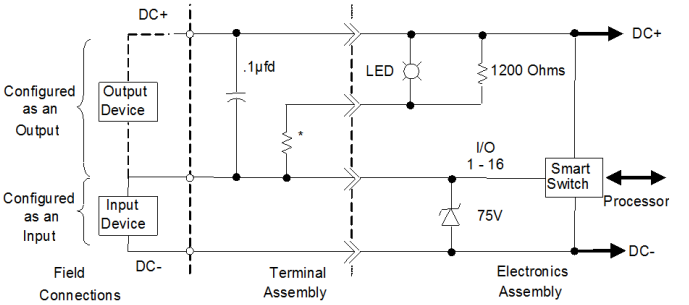
* 5.6K Ohms for 24/48 VDC Blocks
1.8 Ohms for 24 VDC Blocks

For IC66*BRD020 only:



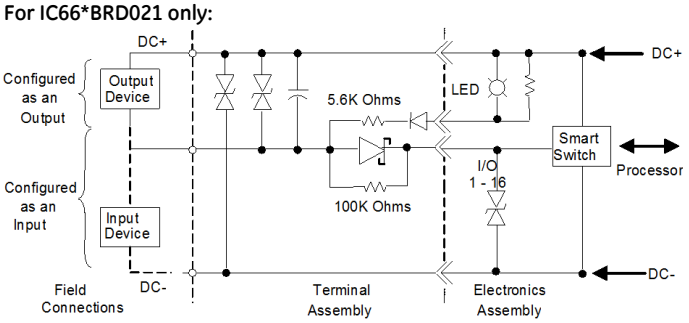
16 Circuit DC Sink I/O Blocks

A DC sink block has all output devices connected to the positive (+) side of the power supply. Inputs control the negative (-) side.



* 5.6K Ohms for 24/48 VDC Blocks
1.8 Ohms for 24 VDC Blocks

For IC66*BRD021 only:



Wiring for GMR Output Groups (IC66*BRD* only)

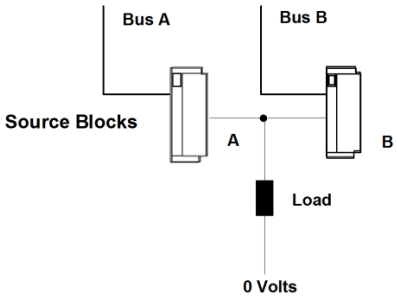
For catalog numbers IC66*BRD*, an isolation or blocking diode is incorporated into the Terminal Assembly IC66*TRD* for every point. These internal diodes make it unnecessary to add external diodes in series with outputs to perform such a blocking/isolation function.

For example, these blocks do not require external diodes in series with "Q16" outputs in "Power feed" applications shown in GFK-1277. External diodes are also not needed in conjunction with the standard external 4700pF capacitor, when these blocks are used in "H", "T" or "I"-pattern GMR Output Groups.

External isolation diodes are still needed on common inputs. See GFK-1277 for additional information about using diodes in GMR applications.

GMR 2-Block T-Output Group

A T-output group consists of two source-type blocks, connected in parallel on one side of the load. The other side of the load is tied to ground. The two blocks must be connected to two different busses.

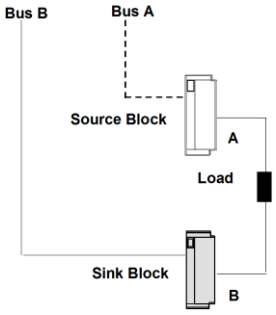


In a 2-block T-output group, current to output loads is shared. Therefore, it is not possible to be sure exactly how much power is being provided by each block. If 16-circuit blocks in a 2-block T output group are configured for No Load fault reporting, the minimum connected load that can be used is 100mA.

In a T-output group, the blocking diodes in block IC66*BRD020 minimize the reverse current into a block that is powered down or not driving the load. The blocking diodes prevent the block from being powered through its I/O points by the other block in the output group.

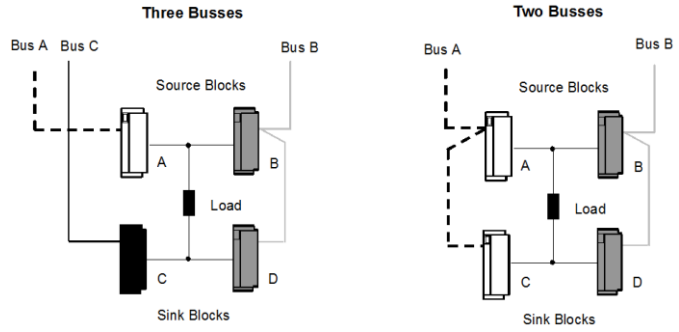
GMR I-Block Output Group

An I-Block Output Group consists of a source-type block connected to one side of the load and a sink-type block connected to the other side. This type of group is most suitable for redundant shutdown applications. Both blocks in an I-Block Output Group must be either 16-circuit or 32-circuit blocks. The two blocks must be connected to two different busses.



GMR H-Block Output Group

In an H-Block Output Group, two source-type blocks are connected in parallel on one side of each load and two sink-type blocks are connected in parallel on the other side. An H-Block Output Group requires either two or three busses.



If the blocks are on three busses, one Source and one Sink block in the group must be on the same bus. If the blocks are on two busses, one Source and one Sink block must be on one bus and the other Source and Sink block must be on the other bus. Blocks located on the same serial bus must always have unique Serial Bus Addresses (SBAs).

LEDs

The block's Unit OK and I/O Enabled LEDs show its operating status:

Unit OK	I/O Enabled	Meaning
ON	ON	Block functioning, CPU communicating
ON	OFF	Block functioning, No CPU communications for 3 bus scans
ON	Blinking	Block functioning, Circuit forced
Blinking	ON	Circuit fault, CPU communicating
Blinking	OFF	Circuit fault, No CPU communications for 3 bus scans
Alternate Blinking		Circuit fault, Circuit forced
Synchronous Blinking		No CPU communications - block number conflict
OFF	OFF	No block power, or block faulty

Each circuit has its own LED. If the circuit is configured as an input, the LED indicates the presence of threshold voltage at the input terminal. If the circuit is configured as an output, the LED indicates the actual state of the load.

Diagnostics

The block always performs its standard diagnostic checks, plus two configurable output diagnostics. The block reports all faults to the Hand-held Monitor, and takes appropriate corrective action.

Short Circuit Diagnostic (standard): If the instantaneous current exceeds 10 Amps at turn-on, the block turns the output off. The block attempts to restart the load; if two attempts are unsuccessful, the output circuit is forced off and the block sends a SHORT CIRCUIT message. The cause of the current surge must be removed, then the diagnostic must be cleared from the HHM or the CPU.

Over-temperature Diagnostic (standard): If the block's internal temperature exceeds 120° C, the block sends an OVERTEMPERATURE message and turns off the circuit to protect its internal electronics.

Failed Switch Diagnostic (standard): For an output, Failed Switch is reported if the circuit's switch state is not the same as its commanded state. The block sends a FAILED SWITCH message identifying the failed circuit. The logic state of the circuit is set to OFF. If the output switch has failed shorted (or closed), current flow is not interrupted when the block forces the output state OFF. Action external to the block must be taken to remedy the problem. Several additional switch faults independent of the output state are detected and reported as Failed Switch faults on both input and output-configured circuits. Examples include loss of communications with the block's internal microprocessor and some internal power supply faults.

Note that in GMR applications, Failed Switch operates differently. See the *GMR User's Manual* for details.

Open Wire Diagnostic (standard): Indicates electrical (not mechanical) malfunctions on a tri-state input. The circuit must have a non-inductive resistor placed as close as practical to the actual dry contacts (such as across the field device terminals), as shown previously.

Overload Diagnostic (configurable): If Overload Shutdown is enabled, the block will turn the output off and send an OVERLOAD message if a load exceeds 2.8 Amps DC continuously for 10ms. Currents exceeding these limits may cause an over-temperature fault.

A load that requires more than 2 Amps DC can be configured not to shut off at this level or send the OVERLOAD message.

No Load Diagnostic (configurable): If a load does not continuously draw 50mA from the output circuit, the block sends a NO LOAD message. A No Load condition may cause an HHM monitoring the block to display 0 for the circuit although there is voltage at the output and the circuit LED is on. This diagnostic should be not be used for circuits on which very small loads (small relays, transformers, or indicating lamps) will draw less than 50 mA.

Note that in GMR applications, No Load operates differently. See the *GMR User's Manual* for details.

Operating Note

When a Hand-held Monitor is used to initiate an output pulse test, it may display a PULSE TEST FAILED message after the test completes. A Pulse Test COMREQ may return Status Code 2048 "Device did not accept the message, or timed out."

This occurs more frequently when the output points have No Load fault reporting enabled and some, or all, of the output points physically have no load, or are operated with load currents less than 50mA. (50mA is the minimum required to avoid a "No Load" fault.) If this issue occurs, repeat the output pulse test command.

Configuration

Each block must be configured with a Hand-held Monitor to:

- Enter its Device Number (serial bus address).
- Enter its Reference Number (required only for IC600 and IC550 series PLCs only).

In addition, unless all circuits on the block will be inputs, the Block I/O Type must be set to either Outputs or Combination *on the Program Block ID screen*.

Note: If a block is configured offline, it must be properly grounded and have a 75Ω resistor installed across its Serial 1 and Serial 2 terminals. See the *Discrete and Analog I/O Blocks User's Manual* for instructions.

The rest of the features can be configured either using a Hand-held Monitor, or by sending a Write Configuration datagram to the block from the host.

Feature	*Circuit or Block*	*Factory Setting*	*Selections*
Baud Rate	B	153.6 std	153.6 std, 153.6 ext, 76.8, 38.4
Block I/O Type	B	input	input, output, combination
Pulse Test	B	enabled	enabled, disabled
Input Filter Time	B	20ms	5-100ms
Circuit I/O Type	C	input	input, output, tri-state input
Report Faults	C	yes	yes, no
Hold Last State	C	no	yes, no
Output Default State	C	off	on, off
Detect No Load	C	yes	yes, no
Overload Shutdown	C	yes	yes, no
BSM Present	B	no	yes, no
Output Timeout	B	3 bus scans	2.5, 10 seconds
Redundancy Mode	B	none	none, standby, duplex, GMR
Duplex Default	B	off	on, off
Config. Protect	B	disabled	enabled, disabled

Configuration Note for Input Auto-testing in GMR Systems

This note applies only to IC66*BBD020M or later and IC66*BBD021M or later and to all versions of IC66*BRD020 and IC66*BRD021 when they are used in configured Input Groups in a GMR system. GMR (Genius Modular Redundancy) is a specific type of application requiring the use of GMR configuration and program software tools.

If Input Auto-testing for the Input Group is turned ON in the GMR Configuration, then during the configuration of the blocks in the group, the Output Pulse Test feature must be disabled. Otherwise, circuits that would normally pass the Input Auto-test are incorrectly reported as having failed. When Output Auto-test is disabled, the Input Auto-test feature functions correctly.

Installation Instructions

Carefully inspect all shipping containers for damage. If any equipment is damaged, notify the delivery service immediately. Save the damaged shipping container for inspection by the delivery service. After unpacking the equipment, record all serial numbers. Save the shipping containers and packing material in case it is necessary to transport or ship any part of the system.

Installation in Hazardous Locations

The following information is for products bearing the UL (C-US) Hazardous Location, CE, and FM Class 1 Division 2 Group A, B, C & D approvals:

- THIS EQUIPMENT IS SUITABLE FOR USE IN CLASS I, DIVISION 2, GROUPS A, B, C, D OR NON-HAZARDOUS LOCATIONS ONLY.
- WARNING - EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2;
- WARNING - EXPLOSION HAZARD - WHEN IN HAZARDOUS LOCATIONS, TURN OFF POWER BEFORE REPLACING OR WIRING MODULES; AND
- WARNING - EXPLOSION HAZARD - DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NONHAZARDOUS.

Block Mounting

I/O blocks are considered "open equipment" and therefore must be installed within a protective enclosure. They should be located in an area that is clean and free of airborne contaminants. There should be adequate cooling airflow.

The block can be mounted right side up, or upside down. Leave at least 2 inches of space between blocks. Mount the block by drilling two screw or bolt holes for 8-32 hardware. Position the block so that the notches in the upper and lower flanges line up with the mounting holes. Mount the block using 8-32 screws. Use star washers to provide ground integrity.

Grounding

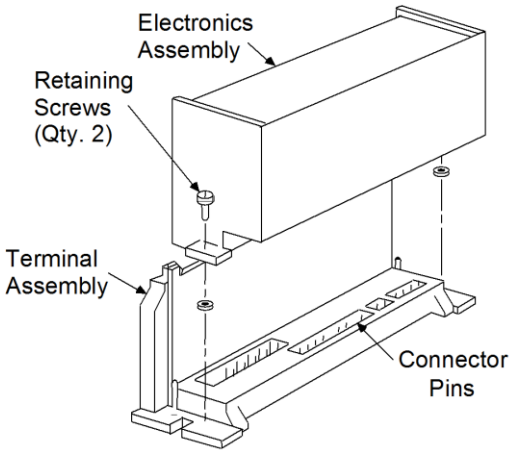
The block's mounting screws must not be used as the only means of grounding the block. Connect the green ground screw on the block to a reliable ground system using a short wire lead, minimum size AWG #12 (average 3.3mm^2 in cross-section).

Warning

If mounting screws do not make good ground connection and the ground screw is not connected to a reliable ground, the block is not grounded. Electrical shock hazard exists. Death or personal injury may result.

Removing an Electronics Assembly

The block's Electronics Assembly can be replaced with a compatible model without removing field wiring or reconfiguring the block.



1. Unscrew the retaining screws at the top and bottom of the block.
2. Using a Block Puller (IC660BLM507), engage the tabs in the first vent slots. Move the tool to the center of the block and squeeze the handle.
3. Pull the Electronics Assembly upward.

Warning

If power is applied to the field terminals, power is also exposed on the connector pins at the base of the Terminal Assembly, and electrical shock hazard exists. Do not touch the connector pins! Death or injury may result.

Inserting an Electronics Assembly

1. Align the Electronics Assembly in the guides and push down firmly.

Caution

Do not exert excessive force; it may damage the block.

2. If unusual resistance is met, remove the Electronics Assembly. If power is applied to the block, DO NOT TOUCH THE CONNECTOR PINS! Inspect the Terminal Assembly, connector receptacle, and connector edge board (on the Electronics Assembly). Be sure the keying matches. Remove any obstacles and reinsert the Electronics Assembly. Pay close attention to the alignment of the guide pins.

   Note: Before hot inserting an Electronics Assembly, be sure that all connector pins are straight and that the Electronics Assembly is lined up squarely with the Terminal Assembly. Failure to insert the Electronics Assembly so that all pins mate simultaneously may result in the block not powering up correctly, or being repeatedly added and lost by its bus controller.

3. Secure the Electronics Assembly with the screws on the top and bottom of the Terminal Assembly.

Replacing an Older Electronics Assembly

If the Electronics Assembly (IC66*EBD020 or EBD021) will replace Electronics Assembly model IC66*ELD020, or ELD021 (only), follow the steps below. Otherwise, some inputs may operate incorrectly.

1. Before removing the old Electronics Assembly from the Terminal Assembly, connect a Hand-held Monitor to the block.
2. If there is any other HHM currently connected anywhere on the bus, it must be *disconnected*, not just turned off.
3. Power up the HHM and proceed to the Block/Bus Status menu. Select the block as the "active" block on the HHM.
4. Proceed to the MNTR/CTRL REF menu. Then:
   a. Monitor one of the first eight circuits on the block (for example, circuit #1). Press the RELEAS key.
   b. Monitor one of the second eight circuits on the block (for example, circuit #90. Press RELEAS.
5. Press the Hand-held Monitor OFF key and disconnect the HHM from the block.
6. Power down the block. Remove the Electronics Assembly.
7. Insert the new Electronics Assembly. Power up the block.

If the new Electronics Assembly was installed without following these steps and the block is powered up, inputs may be operating incorrectly. Connect a Hand-held Monitor and follow the procedure described above.

Block Wiring

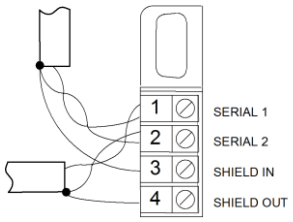
All terminals accept one AWG #12 wire (average 3.3mm^2 in cross-section) or two AWG #14 wires (each average 2.1mm^2 in cross-section). The minimum recommended wire size is AWG #22 (average 0.36mm^2 in cross-section).

Block terminals can also accommodate spade or ring terminals up to 0.27 inch (6.85mm) wide with a minimum opening for a #6 screw, and up to 0.20 inch (5.1mm) depth from the screw center to the back barrier. Be sure unshielded wire ends are not longer than 2 inches (5 cm).

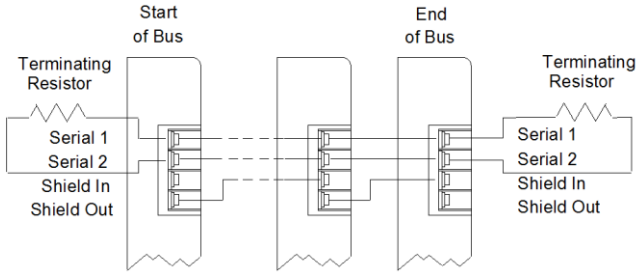
Do not over-torque the terminal screws. Recommended torque for all terminals is 6 in-lb (0.678 Nm).

Serial Bus Wiring

Using one of the cable types recommended in the *System and Communications User's Manual*, connect the serial bus to terminals 1- 4. (If a Bus Switching Module will be connected *directly* to the block, see below instead).



If the block is at either end of the bus, connect a terminating resistor of the appropriate type (see the System and Communications User's Manual for details) across its Serial 1 and Serial 2 terminals.



Wiring for a Bus Switching Module

If the block will be a BSM Controller, attach the Bus Switching Module to the block's serial bus terminals. Attach the serial bus cables to the BSM as described in the *Bus Switching Module datasheet*. Wire the BSM like a load to circuit 1. Connect either BSM pigtail wire to terminal 6. Connect the other BSM wire to DC-.

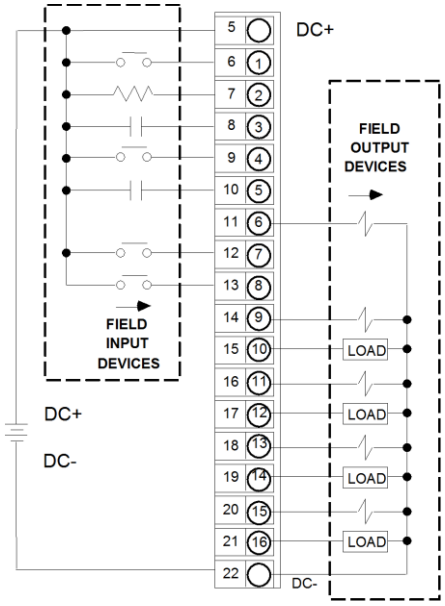
Power Connections

Connect a DC power source to the DC+ terminal (5) and the return to the DC- terminal (22). Depending on the layout and current loads, positive and negative connections can be bussed and made by individual wires back to the block or power source.

Connections for a DC Source Block

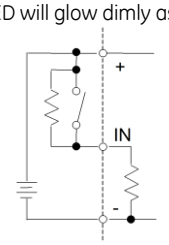
Any circuit can be an input or output. Connect one terminal of the device to the block (terminals 6-21). Connect outputs to DC- and inputs to DC+.

Connect outputs to the negative side of the power supply and inputs to the positive side. No logic inversion is needed.



DC Source Block, Wiring for Tri-State Inputs

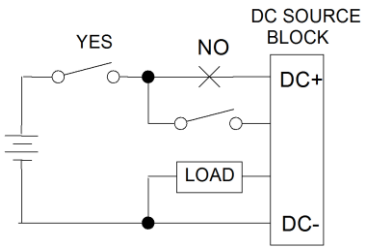
If any input is configured as a Tri-State Input, install a resistor across the dry contacts of the input device. This added resistance is required to use the Open Wire diagnostic. The LED will glow dimly as a result.



For a 24/48 Vdc block, the resistor should be 5.1 kΩ, 1/2 Watt or larger. For a 24 Vdc block, it should be 1.6 kΩ.

DC Source Block, Power Disconnects (non-GMR)

In non-GMR configurations, it is important to wire block power disconnects so that block power and input power will be removed at the same time. Locate the power disconnect as shown below.

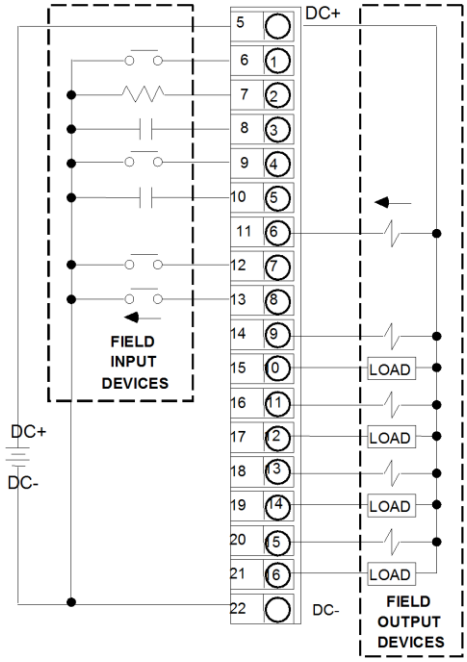


Caution

If circuit power is not removed at the same time as block power, the block may power up when multiple inputs are activated, even though one leg of power has been removed from the block.

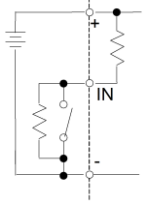
Connections for a DC Sink Block

Any circuit can be an input or output. Connect one terminal of the device to the block (terminals 6-21). Connect outputs to DC+ and inputs to DC-.



DC Sink Block, Wiring for Tri-State Inputs

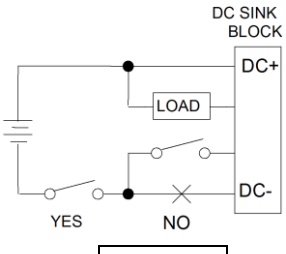
If any input is configured as a Tri-State Input, install a resistor across the dry contacts of the input device. This added resistance is required to use the Open Wire diagnostic. The LED will glow dimly as a result.



For a 24/48 Vdc block, the resistor should be 5.1 kΩ, 1/2 Watt or larger. For a 24 Vdc block, it should be 1.6 kΩ.

DC Sink Block, Power Disconnects (non-GMR)

In non-GMR configurations, it is important to wire block power disconnects so that block power and input power will be removed at the same time. Locate the power disconnect as shown below.



Caution

If circuit power is not removed at the same time as block power, the block may power up when multiple inputs are activated, even though one leg of power has been removed from the block.